

What is claimed is:

1. A light-collecting device, comprising:

 a reflector, shaped like a longish cylinder, a surface of which is a light-reflecting surface finished as a mirror surface; and

 a photo-detector to detect light residing inside said reflector;

 wherein said reflector comprises a light-incoming aperture to guide light inside said reflector, and a perpendicular line at said light-incoming aperture is shifted from a center line of a cross-section perpendicular to a longitudinal direction of said reflector.

2. The light-collecting device of claim 1,

 wherein said light-reflecting surface comprises at least two arc surfaces whose radii of curvatures are different relative to each other.

3. The light-collecting device of claim 1,

 wherein said light-reflecting surface comprises a plurality of plane surfaces, which are inscribed or circumscribed onto at least two arcs whose radii of curvatures are different relative to each other.

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4. The light-collecting device of claim 1,

wherein an area of said cross-section perpendicular to a longitudinal direction of said reflector increases as said cross-section shifts towards an end section of said reflector, at which said photo-detector is disposed.

5. A light-collecting device, comprising:

a reflector, shaped like a longish cylinder, a surface of which is a light-reflecting surface finished as a mirror surface; and

a photo-detector to detect light residing inside said reflector;

wherein said reflector comprises a light-incoming aperture to guide light inside said reflector, and an area of a cross-section perpendicular to a longitudinal direction of said reflector increases as said cross-section shifts towards an end section of said reflector, at which said photo-detector is disposed.

6. The light-collecting device of claim 5,

wherein said light-reflecting surface comprises at least two arc surfaces whose radii of curvatures are different relative to each other.

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7. The light-collecting device of claim 5,

wherein said light-reflecting surface comprises a plurality of plane surfaces, which are inscribed or circumscribed onto at least two arcs whose radii of curvatures are different relative to each other.

8. A light-collecting device, comprising:

a reflector, having a light-incoming aperture and shaped like a longish cylinder, a surface of which is a light-reflecting surface finished as a mirror surface; and a photo-detector to detect light residing inside said reflector;

wherein said light-reflecting surface comprises either at least two arc surfaces, whose radii of curvatures are different relative to each other, or a plurality of plane surfaces, which are inscribed or circumscribed onto at least two arcs whose radii of curvatures are different relative to each other.

9. The light-collecting device of claim 8,

wherein said photo-detector is disposed at each of both end portions of said reflector, and a cross-sectional area of said reflector at a center portion perpendicular to a

longitudinal direction of said reflector is smaller than that at each of said end portions.

10. The light-collecting device of claim 8,

wherein said photo-detector is disposed at an end portion of said reflector, and a cross-sectional area perpendicular to a longitudinal direction of said reflector decreases, as said cross-sectional area shifts towards another end portion of said reflector, at which said photo-detector is not disposed, from said end portion of said reflector, at which said photo-detector is disposed.

11. The light-collecting device of claim 8,

wherein said photo-detector is disposed at a side surface of a center portion of said reflector, and a cross-sectional area of said reflector at said center portion perpendicular to a longitudinal direction of said reflector is larger than that at each of both end portions of said reflector.

12. The light-collecting device of claim 8,

wherein said reflector comprises a glossy metal and/or a multi-layer coating.

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13. The light-collecting device of claim 8,
wherein said reflector has a wavelength selectivity.

14. The light-collecting device of claim 8,
wherein an end-reflecting member is attached to an end
of said reflector, at which said photo-detector is not
disposed.

15. The light-collecting device of claim 14,
wherein said end-reflecting member comprises a glossy
metal and/or a multi-layer coating.

16. The light-collecting device of claim 14,
wherein said end-reflecting member has a wavelength
selectivity.

17. The light-collecting device of claim 8,
wherein an optical filter, having a wavelength
selectivity, is disposed at a light-receiving surface of said
photo-detector, and/or in the vicinity of said light-incoming
aperture.

18. A light-collecting device, comprising:

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a reflector, having a light-incoming aperture and shaped like a longish cylinder, a surface of which is a light-reflecting surface finished as a mirror surface; and

a photo-detector to detect light residing inside said reflector;

wherein a shape of said light-reflecting surface and a position of said light-incoming aperture are established so that a light entered from said light-incoming aperture is repeatedly reflected by said light-reflecting surface so as to rotate in a constant direction in said reflector, viewed from a direction perpendicular to a longitudinal direction of said reflector.

19. The light-collecting device of claim 18,

wherein a perpendicular line at said light-incoming aperture is shifted from a center line of a cross-section perpendicular to a longitudinal direction of said reflector.

20. The light-collecting device of claim 18,

wherein said light-reflecting surface comprises at least two arc surfaces whose radiiuses of curvatures are different relative to each other.

21. The light-collecting device of claim 18,

wherein said light-reflecting surface comprises a plurality of plane surfaces, which are inscribed or circumscribed onto at least two arcs whose radiiuses of curvatures are different relative to each other.

22. The light-collecting device of claim 18,

wherein said light-incoming aperture guides said light inside said reflector, and an area of a cross-section perpendicular to a longitudinal direction of said reflector increases as said cross-section shifts towards an end section of said reflector, at which said photo-detector is disposed.

23. A light-collecting device, comprising:

a reflector, having a light-incoming aperture and shaped like a longish cylinder, a surface of which is a light-reflecting surface finished as a mirror surface; and a photo-detector to detect light residing inside said reflector;

wherein said reflector is sufficiently long in its longitudinal direction, and a shape of said light-reflecting surface and a position of said light-incoming aperture are established so that, viewed from a direction perpendicular to a longitudinal direction of said reflector, after a light entered from said light-incoming aperture is repeatedly

reflected by said light-reflecting surface so as to rotate in a constant direction in said reflector, said light is repeatedly reflected again by said light-reflecting surface so as to rotate in a direction reverse to said constant direction.

24. The light-collecting device of claim 23,
wherein a perpendicular line at said light-incoming aperture is shifted from a center line of a cross-section perpendicular to a longitudinal direction of said reflector.

25. The light-collecting device of claim 23,
wherein said light-reflecting surface comprises at least two arc surfaces whose radii of curvatures are different relative to each other.

26. The light-collecting device of claim 23,
wherein said light-reflecting surface comprises a plurality of plane surfaces, which are inscribed or circumscribed onto at least two arcs whose radii of curvatures are different relative to each other.

27. The light-collecting device of claim 23,

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wherein said light-incoming aperture guides said light inside said reflector, and an area of a cross-section perpendicular to a longitudinal direction of said reflector increases as said cross-section shifts towards an end section of said reflector, at which said photo-detector is disposed.

28. A light-collecting device, comprising:

a reflector, shaped like a longish cylinder, a surface of which is a light-reflecting surface finished as a mirror surface, said reflector comprising a light-incoming aperture to guide light inside said reflector;

a light-guiding member, shaped like a longish element and disposed at said light-incoming aperture, to guide said light in a direction shifted from a center line of a cross-section perpendicular to a longitudinal direction of said reflector; and

a photo-detector to detect said light residing inside said reflector.

29. The light-collecting device of claim 28,

wherein said light-guiding member includes a light-input opening and a light-output opening through which said light is guided inside said reflector, and said light-guiding member is formed in such a shape that a width of said light-

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output opening is shorter than that of said light-input opening in a longitudinal direction of said light-guiding member.

30. The light-collecting device of claim 28,
wherein said light-guiding member includes a light-input opening and a light-output opening, through which said light is guided inside said reflector, and said light-guiding member is formed in such a shape that a thickness of said light-output opening is thinner than that of said light-input opening in a direction perpendicular to a longitudinal direction of said light-guiding member.

31. The light-collecting device of claim 28,
wherein an antireflection coating is applied onto both/either an input-surface and/or an output-surface of said light-guiding member.

32. The light-collecting device of claim 28,
wherein a perpendicular line at said light-incoming aperture is shifted from a center line of a cross-section perpendicular to a longitudinal direction of said reflector.

33. The light-collecting device of claim 28,

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wherein said light-reflecting surface comprises at least two arc surfaces whose radiuses of curvatures are different relative to each other.

34. The light-collecting device of claim 28,

wherein said light-reflecting surface comprises a plurality of plane surfaces, which are inscribed or circumscribed onto at least two arcs whose radiuses of curvatures are different relative to each other.

35. The light-collecting device of claim 28,

wherein an area of a cross-section perpendicular to a longitudinal direction of said reflector increases as said cross-section shifts towards an end section of said reflector, at which said photo-detector is disposed.

36. An image information reading apparatus for reading image information recorded on a sheet by scanning a light-beam on said sheet and detecting light corresponding to said image information recorded on said sheet by means of a photo-detector, comprising:

a light-collecting device cited in claim 1.

37. The image information reading apparatus of claim 36,

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wherein said light is either illuminating light, transmitting light or reflecting light corresponding to said image information recorded on said sheet.

38. An image information reading apparatus for reading image information recorded on a sheet by scanning a light-beam on said sheet and detecting light corresponding to said image information recorded on said sheet by means of a photodetector, comprising:

a light-collecting device cited in claim 5.

39. The image information reading apparatus of claim 38, wherein said light is either illuminating light, transmitting light or reflecting light corresponding to said image information recorded on said sheet.

40. An image information reading apparatus for reading image information recorded on a sheet by scanning a light-beam on said sheet and detecting light corresponding to said image information recorded on said sheet by means of a photodetector, comprising:

a light-collecting device cited in claim 8.

41. The image information reading apparatus of claim 40,

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wherein said light is either illuminating light, transmitting light or reflecting light corresponding to said image information recorded on said sheet.

42. An image information reading apparatus for reading image information recorded on a sheet by scanning a light-beam on said sheet and detecting light corresponding to said image information recorded on said sheet by means of a photodetector, comprising:

a light-collecting device cited in claim 18.

43. The image information reading apparatus of claim 42, wherein said light is either illuminating light, transmitting light or reflecting light corresponding to said image information recorded on said sheet.

44. An image information reading apparatus for reading image information recorded on a sheet by scanning a light-beam on said sheet and detecting light corresponding to said image information recorded on said sheet by means of a photodetector, comprising:

a light-collecting device cited in claim 23.

45. The image information reading apparatus of claim 44,

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wherein said light is either illuminating light, transmitting light or reflecting light corresponding to said image information recorded on said sheet.

46. An image information reading apparatus for reading image information recorded on a sheet by scanning a light-beam on said sheet and detecting light corresponding to said image information recorded on said sheet by means of a photodetector, comprising:

a light-collecting device cited in claim 28.

47. The image information reading apparatus of claim 46, wherein said light is either illuminating light, transmitting light or reflecting light corresponding to said image information recorded on said sheet.